

INDUCED HYPOTENSION IN THE CONTROL OF BLEEDING DURING THE FENESTRATION OPERATION

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Induced hypotension for the control of bleeding during operation, as first described by Gardner,¹ has proved a new and valuable aid for the control of less severe but troublesome bleeding during delicate and confining types of operative procedure such as the fenestration operation.

In approximately 30 per cent of the cases submitted to the Lempert fenestration operation there is troublesome bleeding. This bleeding reduces the speed of the operator, and, because of the effort in removing the blood by irrigation and suction, added trauma is induced in the vicinity of delicate structures such as the ear drum, tympano-meatal flap, and the seventh nerve.

More important, however, is the complete control of bleeding during the preparation of the fenestra. A bloodless field is desirable, as any blood entering the fenestra must be removed from the perilymphatic space within the bony labyrinth. This removal increases the amount of trauma to the membranous labyrinth, and many times it is impossible to remove all of the visible blood even with irrigation and suction.

It therefore becomes obvious that any method of effective control of this bleeding is desirable.

The procedure of controlled induced hypotension has been used in 24 patients undergoing the fenestration operation. In all of these cases the troublesome bleeding encountered during the preparation of the tympano-meatal flap and the construction of the new fenestra has been satisfactorily controlled. The frequency and severity of postoperative labyrinthitis has been reduced, probably due to reduction of the amount of blood entering the fenestra and also less trauma to the membranous labyrinth. Postoperative labyrinthitis usually occurs in patients having increased tendency to bleeding during operation. We therefore believe that the control of bleeding during preparation of the flap and construction of the fenestra contributes to a better hearing result.

Experimental Findings

Kohlstaedt and Page,² in experiments with dogs in 1943, described an ingenious method for the study of shock by arterial bleeding and infusion. Briefly, this method consists in placing a cannula in the femoral artery directed toward the heart. This cannula leads to a closed reservoir into which the dog is bled until the blood pressure is lowered to 30 mm. Hg. The blood is mixed with an anticoagulant during its withdrawal. The arterial pressure is recorded on a kymograph. To raise the blood pressure the blood is infused into the femoral artery by increasing the pressure in the closed reservoir by pumping air into it. This method permits the investigator to reduce the blood pressure to any desired level, hold it there as long as desired, and then bring it back by infusion of the removed blood. In the treatment of hemorrhagic shock these authors found intra-arterial infusion more effective than the intravenous method.

Method

The management of controlled induced hypotension is carried out by the department of anesthesia. The bloodletting is begun at a time selected by the surgeon so that the maximum effect will be obtained during the preparation of the tympano-meatal flap and the creation of the fenestra.

The radial artery is exposed through a longitudinal incision medial to the styloid process of the radius after establishing the presence of a functioning ulnar artery. In the lumen of the artery is secured a two-limbed glass cannula, its tip directed toward the heart. One limb of the cannula is connected by rubber tubing to a vessel containing 50 cc. of 4 per cent citrate solution. The other limb leads to a supply of heparin 0.01 per cent solution, a manometer for registering direct arterial pressure, and a vessel for returning the blood under pressure after filtration. As the apparatus is assembled the tubing, cannulas, and connectors are filled with the heparin solution. At intervals during the time that the apparatus is in use, 5 cc. quantities of the heparin solution are injected into the cannula in order to prevent the formation of a clot within it.

The arterial blood is allowed to flow into the collecting bottles (500 cc. into each) until the blood pressure falls to 80 mm. Hg or until the operative bleeding is satisfactorily controlled. The quantity of blood which it is necessary to withdraw has varied in the present series from 1000 to 3100 cc. During the time that this quantity of blood is outside the body it is essential that the patient be watched with the greatest care in order that the blood pressure may be supported at once, if needed, by the arterial reinfusion of blood.

APPARATUS FOR CLINICAL BLOODLETTING

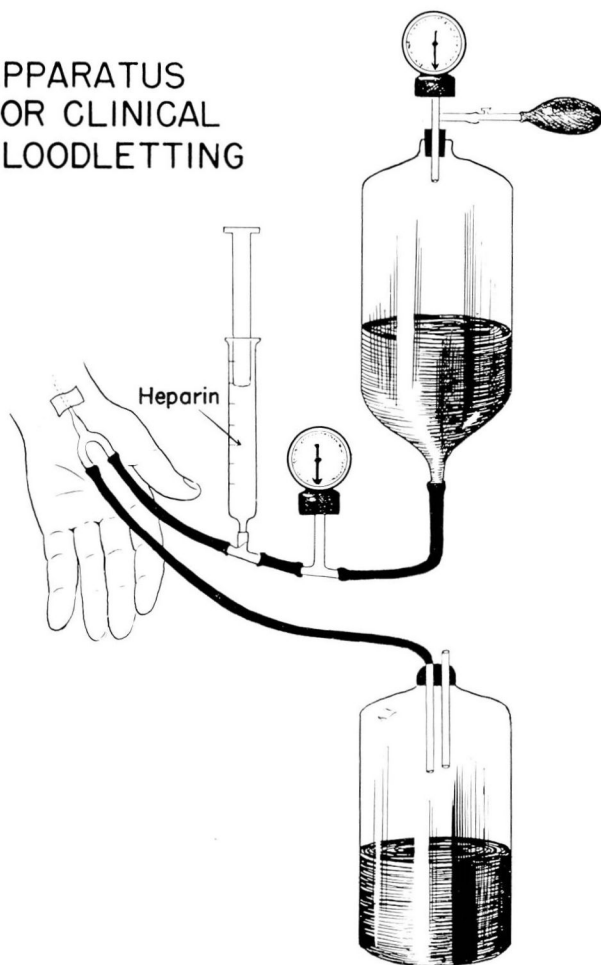


FIGURE. Lower limb of cannula leads to receptacle for collection of blood which is filtered before being returned to patient. Upper limb connects to a heparin supply, arterial pressure manometer, and vessel fitted with pump to control pressure for returning the blood to patient.

At the termination of the period when controlled hypotension is needed, the blood is returned to the patient by the arterial route. Ordinarily the last pint is withheld as the blood volume tends to approach its normal value by the passage of tissue fluids into the vessels. This withheld pint may be returned to the patient during the subsequent twenty-four hours or may not be used at all, affording a mild dehydration effect which, it is believed, reduces postoperative headache and vertigo.

After the fenestra has been completed the tympano-meatal flap is held in place over the fenestra by parresined lace-mesh gauze, and the mastoid cavity is snugly packed with pledgets of sulfathiazole-impregnated vaseline gauze. This packing of the bony cavity is sufficient to prevent recurrence of bleeding after the operation has been completed and the blood pressure has been restored to normal. (Figure)

Precautionary Measures

Controlled induced hypotension is a procedure which should be carried out only by a competent physician. The following precautionary measures deserve special mention:

1. A careful aseptic clot-free technic must be employed throughout.
2. Short "stabilizing periods" during the bloodletting give an accurate estimate of the adaptability of the cardiovascular system.
3. Constant check on the blood pressure during the hypotensive period is essential to avoid sudden serious collapse.
4. The amount of blood withdrawn varies with different patients, but in none should it be rapid and uninterrupted to a previously estimated total amount.
5. The blood (with the exception of a half-liter) should be reinfused before removal of the arterial cannula and before the patient is moved from the operating table.

In the series represented in this article, in which the above precautions were observed, no untoward after-effects or complications have followed the use of this procedure.

Comment

Controlled induced hypotension has been found a very effective and safe procedure in the control of troublesome bleeding during the most difficult and important phases of the fenestration operation. The operating time has also been shortened in these difficult cases.

The incidence of postoperative labyrinthitis has been markedly reduced, and the amount of decibel gain in hearing is, therefore, greater.

The procedure is not advocated for all fenestration cases but should be reserved for those that show a tendency to bleed. If carried out under proper precautions we believe it to be a safe and valuable adjunct in fenestration surgery.

References

1. Gardner, W. J.: The control of bleeding during operation by induced hypotension. *J.A.M.A.* **132**:572-574 (Nov. 9) 1946.
2. Kohlstaedt, K. G., and Page, I. H.: Hemorrhagic hypotension and its treatment by intra-arterial and intravenous infusion of blood. *Arch. Surg.* **47**:178. 1943.